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An assessment of the American plaice stock in NAFO Subarea 2 and Division 3K

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Abstract

The stock of American plaice in NAFO Subarea 2 plus Division 3K remains at a very low level. Catches declined to an average of less than 10 t per year during 1997-1999. Research vessel surveys indicate that the stock size is currently about 10% of the values measured in the early 1980's. Stock size has remained at this low level for several years following the closure of the directed fishery. Changes in the distribution of the fish were observed in the mid to late 1980's, and size and age at maturity declined through the mid 1990's. The relatively small catches from this stock cannot explain the large decline in abundance or the lack of recovery. With no strong year-classes present in the population, and relatively high mortality rates, the prospects for stock rebuilding in the short to medium term continue to be extremely poor.

Résumé

L'abondance du stock de plie canadienne dans la sous-zone 2 et la division 3K de l'OPANO reste très faible. De 1997 à 1999, la moyenne annuelle des captures a baissé à moins de 10 t. Selon des relevés de navires de recherche, la taille du stock représente actuellement environ 10 % des valeurs mesurées au début des années 1980. Après la fermeture de la pêche dirigée à la plie canadienne, la taille du stock est restée à ce niveau peu élevé pendant plusieurs années. Dans la deuxième moitié des années 1980, on a observé des changements dans la répartition des plies canadiennes ainsi qu'une baisse de leur taille et de leur âge à maturité qui s'est poursuivie dans le milieu des années 1990. Les captures relativement faibles de plies appartenant à ce stock ne peuvent expliquer la forte baisse de l'abondance ou le fait que le stock ne se soit pas rétabli. Comme la population ne comprend aucune forte classe d'âge et que les taux de mortalité sont relativement élevés, les chances que le stock se rétablisse à court ou à moyen terme demeurent extrêmement faibles.

Description of the fishery, TAC history

Catches increased steadily throughout the 1960's, peaking at 12,686 t in 1970 (Table. 1). Vessels from Poland and USSR took most of the catches in the 1960's. After the declaration of the 200 mile limit in 1977, catches by non-Canadian fleets were greatly reduced, with the result that the total catch from the stock exceeded 2,000 t on only 2 occasions after 1981. Reported catches from 1994 to 1999 were less than 30 t per year, mostly as by-catch in gillnet fisheries, and are by far the lowest in the time series. This is due to a drastic reduction in the TAC in 1994 (Table 1), as well as the moratorium and subsequent limited fishery for northern cod, which, after 1992, essentially eliminated a major source of A. plaice by-catch. An increase in the catch in 2000 was observed, probably as a result of by-catch from increased gillnetting of G.halibut in Div. 3K. Catches discarded in the shrimp fishery in Subarea 2 + Div. 3K have not been included in the data presented here. Kulka (1995), using observer data, estimated these to be 64 t on average for Div. 2J3KL combined in 1980-94 (range 0 – 228 t). Introduction of Nordmore grates in the shrimp fisheries in these areas in recent years has probably caused a reduction in finfish by-catch, although no recent estimates are available. There are no estimates of by-catch currently available from the newly developed shrimp fishery by vessels less than 65 feet.

In most years, a large percentage of the A. plaice catch came from Div. 3K, with recent exceptions of 1989 and 1990 when a directed fishery on this stock occurred in the autumn in Div. 2J. Catches from Div. 2GH combined have not exceeded 125 t in any year since 1972 (Table 2), and have been negligible in many years (zero since 1992). Only 2 tons of catch have been reported in Subarea 2 from 1993-99. In most years prior to 1991, the inshore catch from the stock ranged between 500 and 2,000 t. The offshore catch fluctuated widely, as it was often more economical for the offshore fleet to fish for A. plaice in the southern divisions of Subarea 3. Offshore fisheries occurred in the autumn of 1989 and 1990 in Div. 2J, often in conjunction with cod fisheries.

Stock assessments were conducted within ICNAF in the mid to late 1970's, and then within CAFSAC from the early 1980's until the early 1990's. TAC regulation began for this stock in 1974, and the TAC was 10,000 tons from 1982-92 (Table 1). After a reduction to 5,000 t for 1993, the FRCC recommended that there be no directed catch from this stock in 1994 and that by-catches be limited to 500 t. This advice was implemented at the beginning of 1994, and was followed by similar advice for 1995-97, although by-catches were limited to a maximum of 100 t per year in this period. The FRCC advice for 1998-2000 did not reference the 100 t figure, therefore the TAC for these years was effectively 0.

Commercial fishery data

CPUE data are available from Canadian offshore otter trawlers for the period 1976-92. However, only twice since 1981 did the directed catch of A. plaice exceed 500 t, and in many years it was negligible. Therefore these data cannot be used as an index of abundance for this stock and by-catch catch rates are not considered to be representative of stock abundance (Brodie et al. 1993). In 1989, a substantial directed

fishery (1457 t) for American plaice occurred in October-November in Div. 2J, with catch rates averaging 714 kg. per hour. This is a relatively high CPUE for this species compared to the long time series of CPUE values in the Canadian fishery for the same species on the Grand Banks (Div 3LNO). The fishery in the fall of 1990 was essentially a mixed one for cod and A. plaice, and no comparable CPUE data are available. Offshore catches were negligible after 1991.

Catch at age data for this stock are available for the period 1984-90, based on samples from the Canadian fisheries. For many years prior to 1984, and for 1991 to 1999, sampling data are either non-existent or inadequate to calculate catch at age. In most years where sampling data are available, ages 9-12 comprised the bulk of the commercial fishery, and there was a declining trend in the catch numbers of older individuals up to 1990 (Brodie et al. 1993).

Research vessel survey data

Stratified random bottom trawl surveys have been conducted in Div. 2G, 2H, 2J, and 3K since the late 1970's, although not annually in Div. 2GH. In 1995, the survey trawl was switched from an Engel 145 Hi-lift trawl with bobbin footgear to a Campelen 1800 shrimp trawl with rockhopper footgear (McCallum and Walsh 1996). The Campelen trawl, with its smaller mesh throughout, was more effective in capturing small fish. A comparative fishing experiment was carried out to quantify the differences, and the results are contained in Warren (1996). Morgan and Brodie (2000) converted the results of surveys in Div. 2J and 3K from 1978-94 into Campelen equivalents for A. plaice. The surveys in Div. 2GH were not converted.

From 1996-99, the fall surveys covered Subarea 2 and Divisions 3KLMNO, although the coverage was not comparable in all years, particularly in Div. 2G, and inshore 3K. Table 3 shows the details of the surveys from 1996-99. Some changes were introduced during this period, notably the addition of inshore strata in Div. 3K in 1996. The inshore strata were surveyed in 1996-98, but not in 1999. Stratification schemes in use from 1997 onward are shown in Figs 1-4 for Divisions 2G, 2H, 2J, and 3K.

Abundance and biomass estimates

The trawlable biomass index of A. plaice in Div. 2G was relatively low (< 610 tons) in all surveys from 1996-99, although coverage was incomplete in all years (Table 4). Biomass was distributed mainly in the 201-300 m strata, and despite the poor coverage in deeper water, there were few A. plaice found deeper than 500 m, and none beyond 750 m. In Div. 2H, the trawlable biomass estimates were between 925 and 1210 tons in 1996-99 (Table 5). The biomass in Div. 2H was more evenly distributed among depth zones, and some A. plaice were found in the 750-1000 m depth range. In Div. 2GH combined, the Engel biomass estimates declined substantially from a level in 1978-81 between 12,000 and 20,000 tons to around 4,000 – 7,000 tons in 1987-88 (Brodie et al. 1995). A Canadian survey in 1991, a Japanese survey in 1996 which gave a 2GH biomass estimate for A. plaice of 446 tons (Yokawa and Satani, 1997), and the recent Campelen surveys show that this decline continued into the 1990's.

In Div. 2J, the trawlable biomass index declined drastically from estimates over 220,000 t in 1982-83 to estimates below 10,000 t in each year after 1991 (Fig. 5) Estimated biomass since the Campelen surveys started in 1995 has been less than 6000 tons in each year (Table 6). The 1999 estimate was 4850 t with an approximate 95% confidence interval of +/- 702 t. Div. 3K shows a similar pattern, with the biomass declining from a high of over 100,000 tons (1981, 1984) to between 10,000 and 16,000 t in the 1992-99 period (Table 7, Fig. 5). The 1999 estimate was 11,715 t, with an approximate 95% confidence interval of +/- 2140 t. It should be noted that the inshore strata were surveyed in Div. 3K only in the years 1996-98, and these values, which are shown in Table 7, have been included in the annual totals. The inshore biomass estimates were similar in all 3 years (range 764 – 992 tons), and accounted for 6 to 9 % of the total biomass estimate in Div. 3K.

Age compositions (mean numbers per tow) from the Campelen surveys in Div. 2GH are presented in Table 8. No fish beyond age 11 were found in Div. 2G, and only in low numbers in Div. 2H. For Div. 2GH combined, ages 2 and 3 were the most abundant age groups in the 1999 survey, and represented the largest catch of any year classes in the 4 year time series. However, the surveys in Div. 2J and 3K in 1999 did not show these year classes to be dominant in the age compositions. Ages 5-7 were dominant in these areas, although the age compositions in the 2 Divisions were somewhat different (Tables 9 and 10). Few fish older than 12 have occurred in the Campelen surveys of 1995-99 (Table 11), consistent with the truncation of the age range observed in the 1980's and 90's. Overall, the abundance index of American plaice for Div. 2J3K combined was at its lowest level in 1999, about 10% of the mean Campelen equivalent value for 1979-83 (Table 11, Fig. 6).

There was a gradual reduction in the numbers of older fish caught in the 1980's surveys, consistent with the commercial fishery data in this period. Virtually all cohorts declined at very high rates from 1990 to 1993 (Tables 9 - 11).

Distribution by depth and area

Shifts in the depth distribution of the A. plaice biomass to deeper water occurred after the mid-1980's in both Division 2J and 3K (Fig. 7, modified from Bowering et al. 1997), and were followed by continued steep declines in the biomass to very low levels. In Div. 2J, plaice in the shallowest depth zone (101-200 m) accounted for 45 to 85 percent of the biomass (unconverted Engel data) in that division in the years 1977 to 1988. In 1989, this percentage dropped sharply to less than 5, and has remained less than 20 % in all subsequent surveys. The proportion of biomass found in depths greater than 500 m was negligible in both areas prior to the 1990's, but increased in the 1990's (Tables 6 and 7, Fig. 7). Recent surveys indicate a decline in the proportion of biomass deeper than 500 m, but the proportion of biomass deeper than 300 m remains high relative to the historic pattern. It should be noted, for Div. 3K, that the strata in the 101-200 m depth range (618 and 619, Fig. 4) were added to the fall surveys in 1984, so prior to then there were no survey sets in this depth range in Div. 3K. Also, the inshore strata in Div. 3K were not included in these comparisons, as these strata were surveyed only in 1996-98.

The spatial distribution of American plaice in 1999 is seen in Fig. 8a in number of fish per tow, and in Fig. 8b in weight of fish per tow. Fish remain widely distributed throughout Subarea 2 and Division 3K in 1999, but at relatively low densities. The southern portion of Division 3K contained several of the largest catches in numbers, although it should be noted that the inshore areas of Div. 3K, which contained A. plaice in the 1996-98 surveys, was not surveyed in 1999. Most of the sets with no A. plaice in 1999 were in the deepest strata, although the central part of Div. 2G and the near-shore area around southern Div. 2J and northern Div. 3K had several sets with no A. plaice.

The concentrations of A. plaice on Hamilton Bank and in the southwestern portion of Div. 2J, present in most surveys up to 1988, were generally not found in subsequent surveys (Brodie et al. 1995). In 1989 and 1990, before the biomass declined to the current low level, A. plaice in Div. 2J were found to the east of Hamilton Bank, and south in the Hawke Channel. Similar changes were observed in Div. 3K, with A. plaice becoming less abundant in the shallower shelf areas west of Funk Island Deep. Fig 9 shows a comparison of the distribution patterns observed in the Campelen surveys of 1995-99.

Mean size and weight at age

Data on mean length and weight at age were available from research vessel survey data. Beginning in 1990, weights for sampled fish were collected at sea during the surveys. Fig. 10 shows the mean size and weight of 6 year old American plaice collected in the fall surveys of Div. 2J and 3K. For Divs 2J and 3K, both sexes showed a decline in size and weight at age 6 from 1990-95, a sharp increase in 1996, and levels in recent years similar to those of the early 1990's. The reason for the fluctuations in 1995-97 is not clear, but it is unlikely the data reflect real changes in growth. The changes appear to be for reasons other than the new survey gear, as the first Campelen survey occurred in 1995. The same pattern also was evident for ages other than age 6. The fish were sampled using a length-based stratified sampling scheme, and no account has been made for potential biases in analysing these data. As well, the sampled fish are generally spread by depth and area throughout an entire Divison, and no analysis has been made of spatial differences on a smaller scale. Further examination of these size and weight at age data is warranted.

Maturity at Age and Size

Proportions mature at age were calculated according to the method described in Morgan and Hoenig (1997) to correct for bias introduced by length-stratified sampling.

Maturities were modelled by cohort using the PROBIT procedure of SAS with a logit link function (SAS Inst. Inc., 1989):

$$pmat = \log\left(\frac{u}{1-u}\right)$$

where: *pmat*= proportion mature at age or length

$$u = \tau + \delta_j v_i + \beta_j$$

τ = intercept
v_i = age i or length i
δ_j = combined age*cohort effect for cohort j
β_j = cohort effect

Before a cohort was included in the model it was first tested separately to ensure that there was sufficient data to which to fit a model. Only cohorts with both a significant slope and intercept were included in the overall model. From this model, estimates of proportion mature at age as well as age at 50% maturity (A_{50}), and length at 50% maturity (L_{50}) were produced for males and females for Div. 2J3K combined.

A_{50} has been declining for both males and females from the earliest cohorts that could be estimated (1968 for females, 1972 for males, Fig 11). Female A_{50} has declined from just under 11 years to 8 years. For males A_{50} has declined from 7 to 4 years. L_{50} has also shown a large decline over the time period (Fig 12). For females, cohorts of the late 1960's had an L_{50} of 36 cm while the most recent cohorts have had an L_{50} of less than 30 cm. For males, cohorts of the early 1970's had L_{50}'s in the mid 20 cm range while the most recent L_{50}'s have averaged around 17 cm. Length at 50% maturity has shown a tendency to increase for the most recent cohorts.

Mortality

Estimates of total mortality (Z) from the Campelen (or equivalent) fall 2J3K survey data were calculated from the abundance index for ages 8+ in year n and 7+ in year n-1 (Table 11, Fig. 13). Despite the low catches, these values were generally higher in the 1990's (mean 1990-99 = 1.27) than in the 1979-89 period (mean =0.78). Age by age estimates of total mortality were also calculated for ages 1 to 16 for Div. 2J3K (Fig. 14). A Lowess smoother has been added to the plots to help visualise trends. The results for ages 2 to 14 are probably the most reliable. The results indicate that there have been increases in mortality over the time period. There is very little indication of a decline in mortality in the years following the end of directed fishing in 1994, and it is quite likely that natural mortality is higher than 0.2.

Catch divided by the index of survey biomass (C/B) gives a proxy for fishing mortality, and the time series of C/B ratios is shown in Fig. 15. Biomass estimates are Campelen equivalents for Div. 2J and 3K combined, and the catches are the reported data for Subarea 2+ Div. 3K combined (Tables 1 and 2). For much of the time period when surveys were available, a substantial part of the commercial catch occurred during the first quarter of the year. Thus the survey estimates of biomass, which were generally from November-December, were taken to represent the biomass on January 1 of the following year. The analysis showed that the C/B ratios were all less than 4%, exceeded 3% on only 2 occasions and have been less than 1% each year from 1991-99. During the years of the largest stock decline (1982-88), the C/B ratio did not reach 2%, and was around 0.5% for 1983-85. Morgan et al. (2000), in a more detailed examination of these data, concluded that fishing mortality could not explain the decline in biomass of this stock which occurred from the early 1980's to the early 1990's.

Relative Cohort Strength

Cohort strengths were estimated using the following model using Campelen or equivalent data from spring RV surveys from 1978 to 1999:

$$\log(N_{ajt}) = \tau + \alpha_a + \delta_j + \varepsilon$$

where: N_{ajt} = number at age *a* belonging to cohort *j* in year *t*

τ = intercept

α_a = age effect for ages *a*=2...5

δ_j = cohort effect

ε =residuals from the fitted model

This model showed no obvious pattern in the residuals and a significant fit to the data.

R^2=0.82, n=85

Source	DF	Type III SS	F value	Pr>F
AGE	3	95.37	51.48	0.0001
COHORT	24	42.15	2.84	0.0007

The strengths of the 1973 to 1996 cohorts, relative to the 1997 cohort, were estimated by this model. The cohorts of 1973 and 1974 were generally stronger than later cohorts (Fig.16), although the 1973 cohort is estimated using only a single observation. The 1983 cohort was almost as strong as the 1974 cohort. There have been no other cohorts of similar strength over the time period.

Assessment

The stock of American plaice in NAFO Subarea 2 plus Division 3K showed a large decline from the early 1980's to the early 1990's. The stock size is currently about one-tenth of the values measured in the early 1980's. Stock size has remained at this low level for several years following the closure of the directed fishery in 1994. The relatively small catches from this stock cannot explain the large decline in abundance or the lack of recovery. Total mortality rates are estimated to be higher in the 1990's than in the 1980's. Changes in the distribution of the fish were observed in the mid to late 1980's, and size and age at maturity declined through the mid 1990's. With no strong year-classes present in the population, and relatively high mortality rates, the prospects for stock rebuilding in the short to medium term continue to be extremely poor.

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Table 1. Nominal catches (1963-92) and TACs (1974-2000) of American plaice, NAFO Subarea plus Division 3K. All values in metric tons.

Year	Canada			Poland	USSR	Other	Total	TAC
	Inshore	Offshore[a]	Total					
1963	116	-	116	675	627	3	1,421	
1964	95	-	95	1,678	1,268	27	3,068	
1965	224	-	224	3,195	2,155	14	5,558	
1966	228	-	228	1,860	765	96	2,949	
1967	395	-	395	1,134	1,701	361	3,591	
1968	1,023	-	1,023	1,889	2,911	128	5,951	
1969	1,689	-	1,869	867	4,129	217	6,902	
1970	3,751	-	3,751	378	8,160	397	12,686	
1971	2,486	-	2,486	233	2,597	32	5,348	
1972	1,188	9	1,197	849	6,760	315	9,121	
1973	1,368	16	1,384	225	3,011	520	5,140	
1974	462	106	568	91	4,643	318	5,620	10,000
1975	813	46	859	95	4,449	344	5,747	8,000
1976	1,741	736	2,477	118	3,373	139	6,107	8,000
1977	1,925	4,691	6,616	27	698	184	7,525	8,000
1978	1,723	1,452	3,175	138	123	86	3,522	6,000
1979	1,792	1,058	2,850	31	39	45	2,965	6,000
1980	1,140	3,746	4,886	39	26	89	5,040	6,000
1981	1,069	6,322	7,401	58	56	30	7,545	6,000
1982	576	1,265	1,841	13	8	38	1,900	10,000
1983	445	863	1,308	266	11	48	1,633	10,000
1984	559	502	1,061	81	6	27	1,175	10,000
1985	558	160	718	14	7	14	753	10,000
1986	1,007	1,903	2,910	1	39	68	3,018	10,000
1987	737	165	902	38	111	12	1,063	10,000
1988	630	252	882	41	21	9	953	10,000
1989	861	3,291	4,152	84	8	4	4,248	10,000
1990	573	1,225	1,798	-	29	-	1,825	10,000
1991	212	282	494	-	14	2	510	10,000
1992	82	21	103	-	-	-	104	10,000
1993	1	76	77	-	-	-	77	5,000
1994			16	-	-	-	16	500[b]
1995			28	-	-	-	28	100[b]
1996			16	-	-	-	16	100[b]
1997			9	-	-	-	9	100[b]
1998			2	-	-	-	2	0
1999			7	-	-	-	7	0
2000			55	-	-	-	55	0

[a]Includes some catches by inshore otter trawlers in some years.
[b]By-catch only.
Data for 1994-2000 are provisional. 2000 is inshore data only, to Oct. 3.

Table 2. Nominal catches (t) of American plaice in Subarea 2 + Division 3K, 1960-2000.

							Canadian only	
Year	2G	2H	2J	3K	Total	TAC	Catch	% of total
1960					16		15	93.8
1961					67		67	100.0
1962					64		60	93.8
1963	0	0	238	1183	1,421		116	8.2
1964	0	21	1193	1854	3,068		95	3.1
1965	1	694	2657	2236	5,588		224	4.0
1966	2	102	575	2270	2,949		228	7.7
1967	1	440	1267	1883	3,591		395	11.0
1968	0	32	938	4981	5,951		1023	17.2
1969	1	160	2268	4473	6,902		1689	24.5
1970	11	103	2128	10444	12,686		3751	29.6
1971	746	58	925	3619	5,348		2486	46.5
1972	1	196	4818	4106	9,121		1197	13.1
1973	0	26	1788	3326	5,140		1384	26.9
1974	0	11	938	4671	5,620	10000	568	10.1
1975	73	0	1101	4573	5,747	8000	859	14.9
1976	24	43	645	5395	6,107	8000	2477	40.6
1977	0	0	224	7301	7,525	8000	6616	87.9
1978	1	49	145	3327	3,522	6000	3175	90.1
1979	0	11	221	2733	2,965	6000	2850	96.1
1980	0	36	142	4862	5,040	6000	4886	96.9
1981	0	38	96	7411	7,545	6000	7401	98.1
1982	0	108	204	1588	1,900	10000	1841	96.9
1983	0	124	168	1341	1,633	10000	1308	80.1
1984	0	54	92	1029	1,175	10000	1061	90.3
1985	0	11	34	708	753	10000	718	95.4
1986	0	4	100	2914	3,018	10000	2910	96.4
1987	0	1	239	823	1,063	10000	902	84.9
1988	0	50	106	797	953	10000	882	92.5
1989	0	9	3225	1014	4,248	10000	4152	97.7
1990	1	1	991	816	1,809	10000	1798	99.4
1991	0	1	69	428	498	10000	494	99.2
1992	0	1	5	97	103	10000	103	100.0
1993	0	0	0	77	77	5000	77	100.0
1994	0	0	0	16	16	500	16	100.0
1995	0	0	0	28	28	100	28	100.0
1996	0	0	1	16	17	100	17	100.0
1997	0	0	1	9	10	100	10	100.0
1998	0	0	0	2	2	0	2	100.0
1999	0	0	0	7	7	0	7	100.0
2000				55	55*	0		

Data for 1994-2000 are provisional.
TAC's for 1994-97 are by-catch only.
* Inshore catch up to October 3, 2000

Table 3. Summary of sets in Campelen fall surveys in SA 2+3 in 1996 - 1999. Depth range is given in meters, numbers of sets appear in parentheses.

Year	Division	Ship			Total
		Teleost	*W.Templeman*	*A.Needler*	
1996	2G	127 - 1436 (47)			47
	2H	122 - 1415 (77)			77
	2J	126 - 1410 (117)			117
	3K	111 - 1368 (115)	126 - 472 (60)		175
	3L	805 - 1433 (31)	51 - 671 (180)		211
	3M	784 - 1400 (18)	127 - 707 (68)		86
	3N	390 - 1147 (13)		37 - 309 (54)	67
	3O	68 - 690 (24)	65 - 139 (19)	63 - 304 (15)	58
					838
1997	2G	201-1209 (69)			69
	2H	220-1382 (71)			71
	2J	123-1488 (117)			117
	3K	143-1431 (155)	117-421 (20)		175
	3L	161-1436 (71)	35-714 (134)		205
	3M	799-1379 (26)			26
	3N		41-769 (74)		74
	3O		62-611 (73)		73
					810

Year	Division	Ship		Total
		Teleost	*W.Templeman*	
1998	2G	143-1488 (34)		34
	2H	98-1473 (83)		83
	2J	126-1398 (118)		118
	3K	122-1415 (154)	121-346 (17)	171
	3L	691-1437 (32)	34-675 (172)	204
	3M	768-1436 (26)		26
	3N	834-1447 (12)	37-1079 (78)	90
	3O		82-1076 (87)	87
				813
1999	2G	142-1415(69)		69
	2H	104-1454(81)		81
	2J	109-1375(115)		115
	3K	146-1477(154)		154
	3L	1366(1)	63-1407 (169)	170
	3M	853-1403(12)		12
	3N		39-664(68)	68
	3O		58-692(75)	75
				744

Table 4. Biomass (t) per stratum of A. plaice from fall Campelen surveys, Div. 2G, 1996-99.

stratum	depth(m)	1996	1997	1998	1999
909	<200	55		67	3
910	<200	0		4	50
925	<200	0			1
901	201-300	172	57		120
908	201-300	37	56	111	115
911	201-300	130	68	88	109
924	201-300	0	51		45
926	201-300	3	7		0
902	301-400	6	8	0	10
912	301-400		1	0	0.2
923	301-400	35	49		13
927	301-400	6	0		0
903	401-500		4	0	1
913	401-500		0.3	0	3
922	401-500		0		5
928	401-500	18	21		4
904	501-750		6	1	14
914	501-750		0	2	2
921	501-750		0		4
929	501-750	0	7		
905	751-1000			0	0
915	751-1000				
920	751-1000				
906	1001-1250		0	0	0
916	1001-1250			0	
919	1001-1250		0		
907	1251-1500				0
917	1251-1500				
918	1251-1500				
Sum	<200	55.0	0.0	71.0	71.0
	201-300	342.0	239.0	199.0	438.0
	301-500	65.0	83.3	0.0	83.3
	>500	0.0	13.0	3.0	16.0
	Total	462.0	335.3	273.0	608.3
Proportion					
	<200	0.119	0.000	0.260	0.117
	201-300	0.740	0.713	0.729	0.720
	301-500	0.141	0.248	0.000	0.137
	>500	0.000	0.039	0.011	0.026

Table 5. Biomass (t) per stratum of A. plaice from fall Campelen surveys, Div. 2H, 1996-99.

stratum	depth (m)	1996	1997	1998	1999
930	<200	49		98	148
954	<200	89		53	85
956	<200	163		72	106
957	<200	100		33	27
931	201-300	184	32	56	72
943	201-300	0	5	10	16
950	201-300	86	9		15
953	201-300	24	40	38	26
955	201-300	90	80	67	26
958	201-300	48	98	59	98
932	301-400	6	8	2	6
944	301-400	41	111	81	98
949	301-400	98	26		
952	301-400	12	204	2	54
959	301-400	7	7	1	9
933	401-500	4	4	8	8
942	401-500	0.3	0.5	0.1	2
945	401-500	16	90	81	26
948	401-500	8	96	126	
951	401-500	89	11	20	26
960	401-500	0.4	13	8	24
934	501-750	1	17	9	16
941	501-750	1	0	0	9
946	501-750	66	74	41	120
947	501-750	13	26	34	84
961	501-750	10	13	12	25
935	751-1000		7	12	0
940	751-1000	0	0	5	0
962	751-1000	0	5	0	0
936	1001-1250		0	0	
939	1001-1250	0	0		0
963	1001-1250	0	0	0	0
937	1251-1500		0	0	
938	1251-1500	0	0	0	0
964	1251-1500	0	0	0	0
Sum	<200	401.0	0.0	256.0	366.0
	201-300	432.0	264.0	230.0	253.0
	301-500	281.7	570.5	329.1	253.0
	>500	91.0	142.0	113.0	254.0
	Total	1205.7	976.5	928.1	1126.0
Proportion					
	<200	0.333	0.000	0.276	0.325
	201-300	0.358	0.270	0.248	0.225
	301-500	0.234	0.584	0.355	0.225
	>500	0.075	0.145	0.122	0.226

Table 6. Biomass (t) per stratum of A. plaice from fall Campelen surveys, Div. 2J, 1995 to 1999

Depth Range (m)	Stratum	Area (sq. nm)	Trawlable Units (000)	1995	1996	1997	1998	1999
101-200	201	633	87.076		89	10	94	20
	205	1594	219.272		133	52	148	154
	206	1870	257.239	74	89	239	452	204
	207	2264	311.438	18	37	131	113	50
	237	733	100.832	0	31	15	2	39
	238	778	107.022		7	5	18	65
201-300	202	621	85.425	0	242	71	225	94
	209	680	93.542	122	94	137	84	141
	210	1035	142.376	158	336	210	174	250
	213	1583	217.759	86	174	492	542	446
	214	1341	184.469	49	257	260	334	327
	215	1302	179.105	16	426	132	272	174
	228	2196	302.084	351	704	706	648	391
	234	530	72.907		1	74	58	7
301-400	203	487	66.992	251	205	126	157	234
	208	588	80.886	593	49	1320	659	656
	211	251	34.528	80	42	60	96	390
	216	360	49.522	61	84	109	46	46
	222	450	61.902	9	117	132	65	87
	229	536	73.733	77	52	44	103	131
401-500	204	288	39.618	72	329	187	211	69
	217	241	33.152	91	31	80	47	9
	223	158	21.735	47	30	26	46	51
	227	598	82.262	69	108	88	109	58
	235	414	56.950	261	170	174	383	305
	240	133	18.296	14	9	0	0	12
501-750	212	557	76.622	670	144	283	220	228
	218	362	49.797	101	130	117	79	83
	224	228	31.364	65	264	118	128	12
	230	185	25.449	72	17	20	19	27
	239	120	16.507	109	151	57	60	71
751-1000	219	283	38.930	41	19	0	29	14
	231	186	25.586	78	0	0	11	0
	236	193	26.549	116	0	8	14	2
1001-1250	220	303	41.681		0	0	0	
	225	195	26.824		4	9	0	6
	232	228	31.364		0	0	0	0
1251-1500	221	330	45.395		0	0	0	0
	226	201	27.650		0	0	0	0
	233	237	32.602		0	0	0	0
101-200		7872	1082.879	92	386	452	827	532
201-300		9288	1277.667	782	2234	2082	2337	1830
301-500		4504	619.576	1625	1226	2346	1922	2048
>500		3608	496.320	1252	729	612	560	443
Total		25272	3476.442	3751	4575	5492	5646	4853
Proportion								
101-200		0.311		0.025	0.084	0.082	0.146	0.110
201-300		0.368		0.208	0.488	0.379	0.414	0.377
301-500		0.178		0.433	0.268	0.427	0.340	0.422
>500		0.143		0.334	0.159	0.111	0.099	0.091

Table 7. Biomass (t) per stratum of A. plaice from fall Campelen surveys, Div. 3K, 1995 to 1999
Inshore strata surveyed in 1998 -98. Strata 611 and 621 modified slightly in 1997.

Depth Range(m)	Stratum	Area (sq. nm.)	Trawlable units ('000)	1995	1996	1997	1998	1999
	INSHORE							
101-200	608	798	109.774		56	27	31	
	612	445	61.215		26	49	11	
	616	250	34.390		27	4	1	
201-300	609	342	47.046		45	78	29	
	611	573	78.823		37	100	247	
	615	251	34.527		140	72	70	
301-400	610	256	35.216		405	445	156	
	614	263	36.179		82	199	211	
401-500	613	30	4.127		12	20	8	
	OFFSHORE							
101-200	618	1347	185.295	38	7	26	42	20
	619	1753	241.145	78	4	15	10	17
201-300	620	2545	350.093	190	310	394	169	101
	621	2537	348.992	1547	938	686	775	831
	624	1105	152.005	112	193	320	275	305
	634	1555	213.907	291	316	880	431	261
	635	1274	175.253	112	190	438	583	428
	636	1455	200.151	440	536	707	627	614
	637	1132	155.719	230	368	260	631	657
301-400	617	593	81.574	39	181	337	319	204
	623	494	67.955	81	129	180	105	93
	625	888	122.154	72	224	380	178	133
	626	1113	153.105	471	691	663	882	662
	628	1085	149.254	506	789	416	1260	690
	629	495	68.093	369	290	157	252	260
	630	332	45.670	163	229	74	152	153
	633	2067	284.339	431	692	572	306	404
	638	2059	283.236	948	1528	1116	1939	1736
	639	1463	201.252	310	867	585	694	814
401-500	622	691	95.055	191	143	287	648	327
	627	1255	172.639	1367	996	652	2051	2040
	631	1321	181.718	586	485	314	239	367
	640	69	9.492	13	26	14	8	38
	645	216	29.713	3	42	2	23	30
	650	134	18.433	33	56	201	49	76
501-750	641	230	31.639	65	82	23	7	197
	646	325	44.707	0	111	0	0	18
	651	359	49.384	216	67	108	163	353
751-1000	642	418	57.501	115	0	0	0	0
	647	360	49.522	6	108	54	0	0
	652	516	70.982	636	1131	335	147	85
1001-1250	643	733	100.832	15	0	9	0	0
	648	228	31.364		0	0	0	0
	653	531	73.045	18	22	0	21	0
1251-1500	644	474	65.204	0	0	0	0	0
	649	212	29.163		0	0	0	0
	654	479	65.892	0	0	0	0	0
Inshore		1347	185.295		810	992	764	
101-200		3100	426.440	116	11	41	52	37
201-300		11803	1596.120	2922	2851	3845	3491	2997
301-500		14275	1963.684	5563	7368	5930	9195	8027
>500		4865	669.236	1071	1521	529	338	853
Total		35190	4840.774	9672	12561	11137	13840	11714
Proportion								
Inshore		0.038			0.064	0.089	0.055	
101-200		0.088		0.012	0.001	0.004	0.004	0.003
201-300		0.330		0.302	0.227	0.327	0.252	0.256
301-500		0.406		0.575	0.587	0.532	0.664	0.685
>500		0.138		0.111	0.121	0.047	0.024	0.058

Table 8. Mean number of American plaice per tow from Campelen surveys in Div. 2GH, 1996-99.

	2G			
Age	1996	1997	1998	1999
0				
1	0.01		0.16	0.15
2	0.09	0.05	0.22	0.59
3	0.02	0.19	0.36	0.56
4	0.14	0.05	0.46	0.49
5	0.42	0.12	0.25	0.61
6	0.39	0.27	0.14	0.23
7	0.24	0.28	0.24	0.11
8	0.09	0.24	0.19	0.14
9	0.03	0.20	0.07	0.09
10		0.04	0.02	0.01
11		0.04	0.01	
12				
13				
14				
15				
16				
unk	0.02			
Total	1.45	1.48	2.12	2.98

	2H			
Age	1996	1997	1998	1999
0				
1	0.27		0.05	0.33
2	0.81	0.09	1.25	3.19
3	0.35	0.34	0.95	3.27
4	0.82	0.23	1.09	1.52
5	1.24	0.50	0.93	1.43
6	1.07	0.73	0.44	0.63
7	0.75	1.02	0.52	0.32
8	0.24	0.96	0.23	0.25
9	0.10	0.50	0.20	0.18
10	0.01	0.16	0.07	0.06
11		0.06	0.04	0.06
12		0.02	0.01	
13	0.01	0.02		
14		0.01	0.02	
15	0.01	0.01	0.01	
16				
unk				
Total	5.68	4.65	5.81	11.24

Table 9. Mean number per tow of American plaice, by age, from fall surveys in Div. 2J. Data inCampelen equivalents.

Age/Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.03	0.55	0.27	0.08
2	0.00	0.00	0.00	0.16	0.13	0.00	0.00	0.25	0.00	0.14	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.50	0.44	0.48	0.86	0.58
3	0.40	0.00	0.00	0.16	1.71	0.42	0.00	0.64	2.82	0.88	0.00	0.92	0.48	0.71	0.00	0.00	0.00	0.22	1.19	1.24	0.70	1.18
4	8.34	3.08	0.72	3.34	2.07	4.48	2.47	0.98	2.49	3.52	1.26	2.82	1.54	1.27	0.78	1.04	1.81	1.01	1.70	1.83	0.94	0.77
5	30.20	15.48	4.04	10.36	14.14	6.34	5.80	7.63	5.48	3.14	5.55	9.22	3.96	5.24	2.91	2.48	2.16	1.06	2.38	2.13	2.00	2.53
6	64.82	43.85	20.61	41.02	27.20	23.62	12.89	17.95	13.85	11.28	9.80	20.74	13.08	8.94	4.70	5.70	5.27	1.89	2.40	2.09	2.82	1.99
7	79.74	54.89	72.78	41.35	61.20	54.18	29.26	28.80	20.84	10.96	12.33	15.45	14.91	6.82	5.34	3.91	5.84	2.80	0.88	1.72	2.24	1.17
8	42.75	38.98	42.02	24.47	58.26	47.33	29.83	25.01	15.68	8.84	12.75	13.85	8.66	4.64	2.38	2.55	2.58	1.83	0.34	1.22	0.87	0.85
9	30.28	18.48	17.92	8.86	44.77	20.41	16.96	15.82	10.95	5.02	8.72	9.01	6.31	1.57	0.78	0.49	0.48	0.31	0.06	0.58	0.45	0.25
10	12.58	6.69	8.96	4.39	15.33	12.57	8.05	4.33	4.08	3.03	4.57	3.33	3.80	0.48	0.24	0.25	0.11	0.03	0.01	0.21	0.18	0.07
11	5.93	2.56	4.49	1.58	4.92	6.20	3.08	1.62	1.05	0.89	1.82	2.00	0.94	0.23	0.14	0.07	0.01	0.01	0.00	0.05	0.03	0.01
12	4.34	3.15	3.86	0.63	2.97	1.77	1.01	1.02	0.88	0.54	0.58	0.70	0.59	0.08	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.01
13	3.58	1.84	1.69	0.05	1.83	1.13	0.84	0.49	0.38	0.21	0.23	0.18	0.20	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	1.84	0.55	1.00	0.00	0.80	0.29	0.15	0.08	0.08	0.05	0.02	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	1.17	0.14	0.30	0.00	0.15	0.11	0.06	0.00	0.03	0.01	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.56	0.00	0.13	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.19	0.00	0.06	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unk	0.37	0.00	0.00	0.06	0.02	0.01	0.30	0.27	0.00	0.38	0.00	0.01	0.00	0.04	0.00	0.00	0.00	0.02	0.01	0.03	0.01	0.00
TOTAL	293.84	187.35	178.81	134.45	235.84	178.87	104.80	104.89	78.39	48.90	57.43	78.35	54.35	30.05	17.32	16.47	17.86	9.76	9.43	12.15	11.17	9.49

Table 10. Mean number per tow of American plaice, by age, from fall surveys in Div. 3K. Data converted to Campelen equivalents.

Age/Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.20	0.00	0.00	0.00	0.00	0.08	0.00	0.20	0.21	0.13	0.00	0.15	0.00	0.00	0.00	0.00	0.14	0.01	0.08	0.09	0.05
2	0.00	0.00	0.22	0.00	0.17	0.11	1.02	2.47	1.14	0.57	2.84	1.15	0.00	0.16	0.02	0.00	0.73	1.99	0.40	0.08	0.38	0.20
3	3.22	0.18	1.26	1.54	3.31	5.90	1.67	2.62	16.99	4.98	4.21	6.80	1.19	0.36	0.94	1.08	0.58	1.19	3.86	0.30	0.73	0.35
4	50.56	4.25	1.32	1.92	3.74	5.40	11.77	4.69	16.32	15.49	7.16	10.00	2.82	3.04	1.28	3.20	2.13	1.95	6.16	1.69	1.36	0.77
5	84.34	18.61	8.30	5.09	5.56	12.07	11.91	9.88	10.87	10.92	20.76	10.47	4.88	6.96	4.07	8.21	3.71	4.17	6.89	5.31	4.01	2.09
6	85.28	27.85	19.45	10.15	9.74	16.00	22.33	10.25	13.84	11.58	10.40	17.84	6.29	6.95	5.40	9.55	5.91	5.78	3.82	5.28	4.06	3.81
7	51.67	24.97	32.64	23.53	14.35	19.17	14.40	12.01	10.22	9.39	6.95	11.27	6.52	5.08	3.84	3.98	9.08	4.19	1.33	2.36	3.52	2.69
8	21.15	17.46	15.97	23.32	13.94	13.39	18.03	8.24	9.27	6.51	4.83	4.74	3.14	2.42	1.63	2.16	2.70	1.70	0.21	0.95	1.93	1.47
9	16.56	9.84	7.63	9.12	8.17	4.02	8.96	4.75	6.23	4.25	2.85	4.13	1.82	1.32	0.81	0.63	0.70	0.39	0.10	0.60	0.73	0.77
10	9.10	5.26	4.98	7.70	3.39	2.72	2.92	2.02	2.96	1.61	1.39	1.71	0.76	0.55	0.32	0.27	0.26	0.13	0.02	0.10	0.12	0.32
11	4.75	2.15	2.71	1.93	1.90	1.00	1.89	0.85	1.16	0.71	0.59	0.85	0.42	0.15	0.05	0.13	0.05	0.02	0.00	0.04	0.09	0.11
12	3.78	2.63	2.11	2.61	0.92	1.08	1.10	0.91	0.78	0.46	0.32	0.57	0.19	0.10	0.05	0.06	0.01	0.00	0.01	0.02	0.02	0.00
13	3.23	1.32	1.04	1.25	0.74	0.50	0.53	0.44	0.37	0.17	0.16	0.23	0.14	0.04	0.02	0.00	0.00	0.00	0.00	0.01	0.01	0.00
14	1.87	0.43	0.67	0.53	0.37	0.26	0.23	0.11	0.14	0.10	0.11	0.09	0.01	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	1.30	0.17	0.27	0.33	0.20	0.10	0.15	0.07	0.04	0.06	0.02	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.67	0.15	0.10	0.23	0.06	0.02	0.04	0.02	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.25	0.01	0.06	0.00	0.04	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.08	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.00	0.01
Unk	0.37	0.02	0.00	0.11	0.01	0.04	0.00	0.00	0.01	0.01	0.24	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	337.97	115.53	94.75	90.39	64.61	81.75	94.84	59.33	90.84	67.04	62.77	69.53	28.35	27.76	18.44	26.27	25.86	21.66	22.85	18.84	17.07	12.84

Table 11. Abundance at age (millions) in from surveys. Div. 2J3K combined. All data in Campelen equivalents.

Age/Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.823	0.000	0.000	0.909	0.000	0.361	0.000	0.801	0.906	0.534	0.000	0.862	0.000	0.000	0.000	0.000	0.899	0.220	2.298	1.365	0.559
2	0.000	0.000	0.676	0.517	1.076	0.398	4.290	11.526	4.857	2.868	10.589	5.502	0.000	0.893	0.071	0.000	3.136	10.550	3.584	2.089	4.926	2.917
3	10.857	0.561	3.953	6.566	18.197	23.207	7.070	13.432	77.088	24.119	16.958	29.540	6.749	3.865	4.088	4.739	2.541	6.098	25.845	5.862	6.161	5.877
4	169.880	21.450	6.074	18.298	21.008	34.602	57.312	23.475	73.342	77.737	32.813	49.001	17.221	19.913	8.128	17.374	14.453	11.818	37.354	15.003	10.227	6.219
5	330.183	89.154	35.962	57.393	68.867	65.374	68.390	67.886	61.215	56.936	101.296	71.507	34.045	47.215	27.086	43.794	23.088	22.233	42.400	34.453	27.441	18.455
6	415.780	202.437	116.690	172.246	125.149	136.133	134.514	102.886	100.404	86.289	73.146	138.340	69.838	59.203	38.673	59.972	42.745	31.970	27.832	34.086	29.929	24.580
7	346.147	223.013	299.064	225.748	252.583	247.395	152.712	145.822	108.040	75.821	67.348	94.929	76.782	44.207	33.973	29.878	57.864	27.159	9.886	18.006	25.713	18.484
8	166.807	157.524	163.683	170.403	241.508	203.729	169.464	117.159	88.057	58.623	60.152	63.521	41.841	25.560	14.843	17.571	20.095	12.970	2.273	9.072	12.867	9.785
9	122.980	74.263	72.377	57.907	175.856	81.373	82.440	72.088	60.523	34.505	39.316	45.689	28.433	10.845	6.006	4.343	4.580	2.672	0.882	5.081	5.292	4.442
10	57.888	34.136	39.861	44.356	62.485	51.010	31.245	22.837	24.985	16.751	20.181	17.543	15.085	3.973	2.124	1.974	1.512	0.881	0.140	1.186	1.225	1.713
11	28.886	13.513	20.616	12.640	23.139	23.856	16.799	8.977	8.077	5.914	7.541	9.844	4.878	1.394	0.674	0.807	0.271	0.110	0.000	0.414	0.541	0.554
12	21.882	16.560	17.035	12.274	13.109	9.706	7.792	7.283	6.026	3.745	3.135	4.553	2.771	0.705	0.381	0.316	0.063	0.022	0.035	0.069	0.110	0.031
13	18.436	8.982	7.829	5.053	8.735	5.550	4.838	3.518	2.705	1.426	1.388	1.488	1.240	0.241	0.143	0.013	0.013	0.000	0.000	0.000	0.027	0.027
14	9.050	2.880	4.817	2.073	4.024	1.824	1.423	0.712	0.899	0.604	1.465	1.357	0.126	0.126	0.044	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	6.790	0.804	1.650	1.282	1.249	0.726	0.813	0.311	0.254	0.278	0.099	0.284	0.122	0.018	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	3.387	0.804	0.857	0.894	0.464	0.090	0.153	0.108	0.000	0.087	0.000	0.057	0.059	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	1.228	0.048	0.283	0.000	0.211	0.025	0.056	0.000	0.000	0.000	0.035	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.280	0.103	0.141	0.130	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	(.000	0.000	0.000	0.000	0.000	0.000
19	0.055	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.000	0.145	0.011	0.000	0.000	0.047	0.075	0.139	0.036	0.000
Unk	1.087	0.000	0.000	0.634	0.073	0.135	0.954	0.879	0.014	1.282	0.000	0.052	0.000	0.145	0.011	0.000	0.000	0.047	0.075	0.139	0.036	0.000
Total	1711.300	856.757	792.389	786.414	1015.879	883.202	740.615	608.570	616.987	446.890	435.966	533.168	309.793	218.102	136.237	180.780	170.162	127.358	148.304	127.810	125.862	91.443

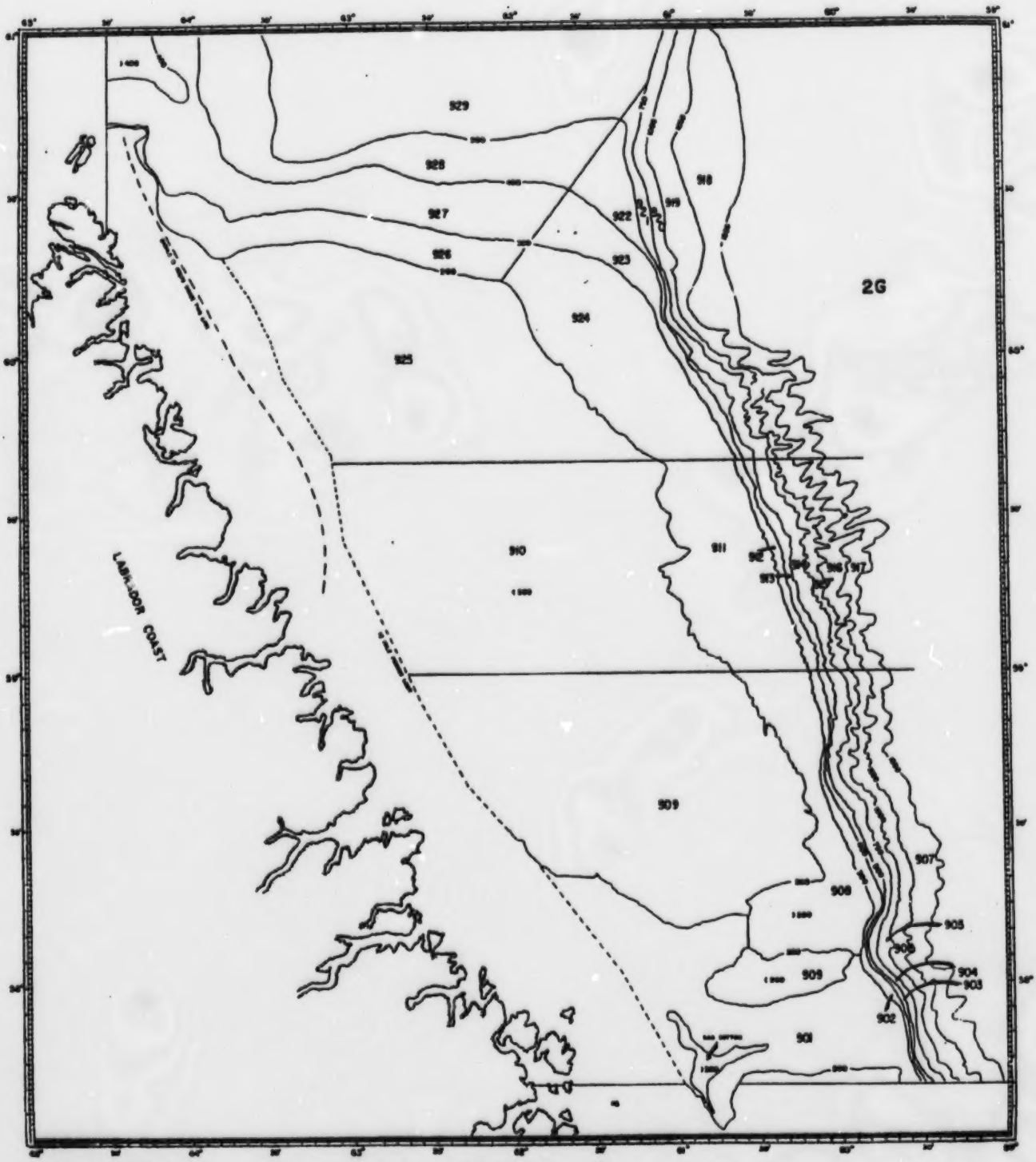

Fig. 1. Stratification used in trawl surveys of NAFO Div. 2G.

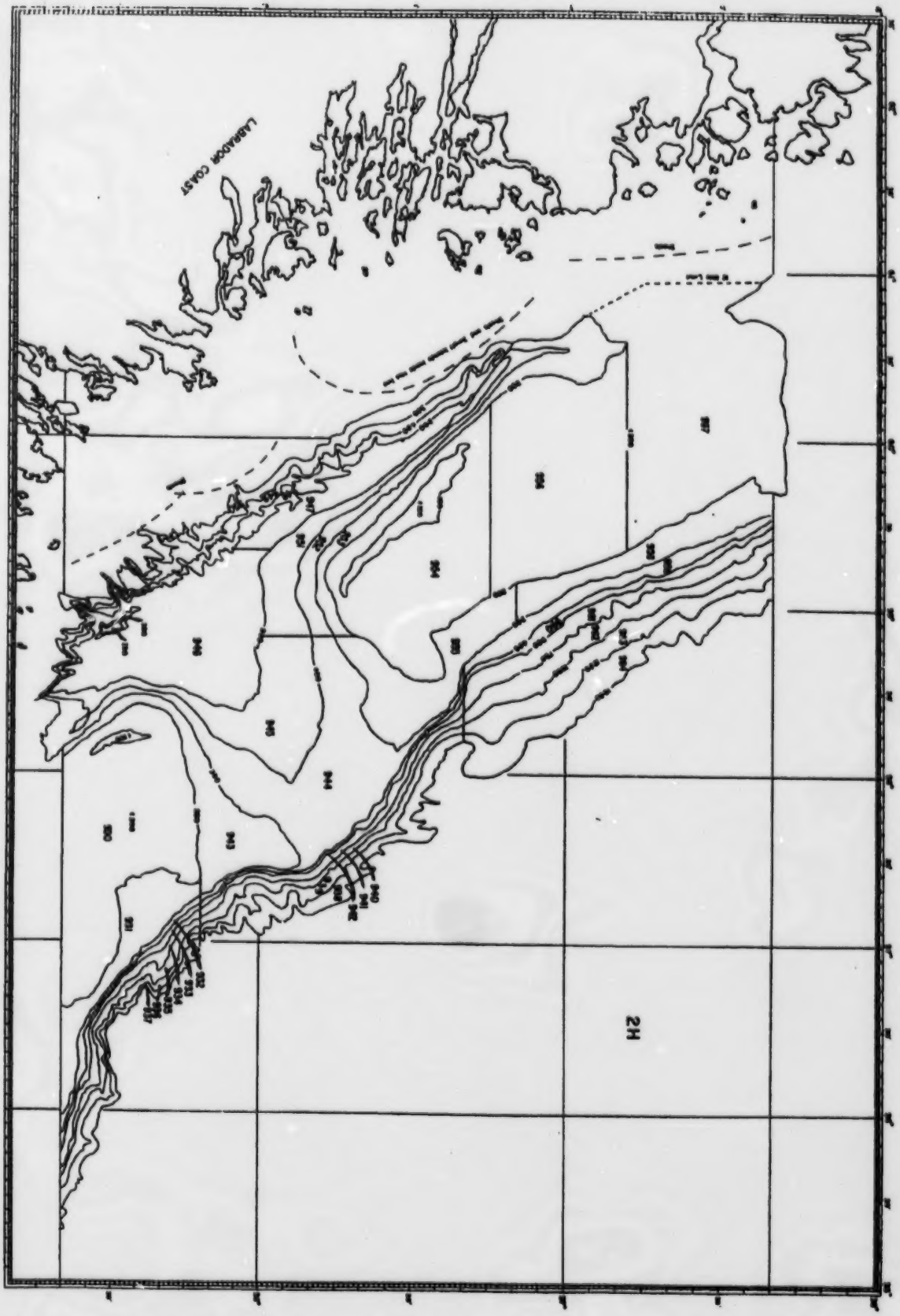

Fig. 2. Stratification scheme used in trawl surveys in Div. 2H.

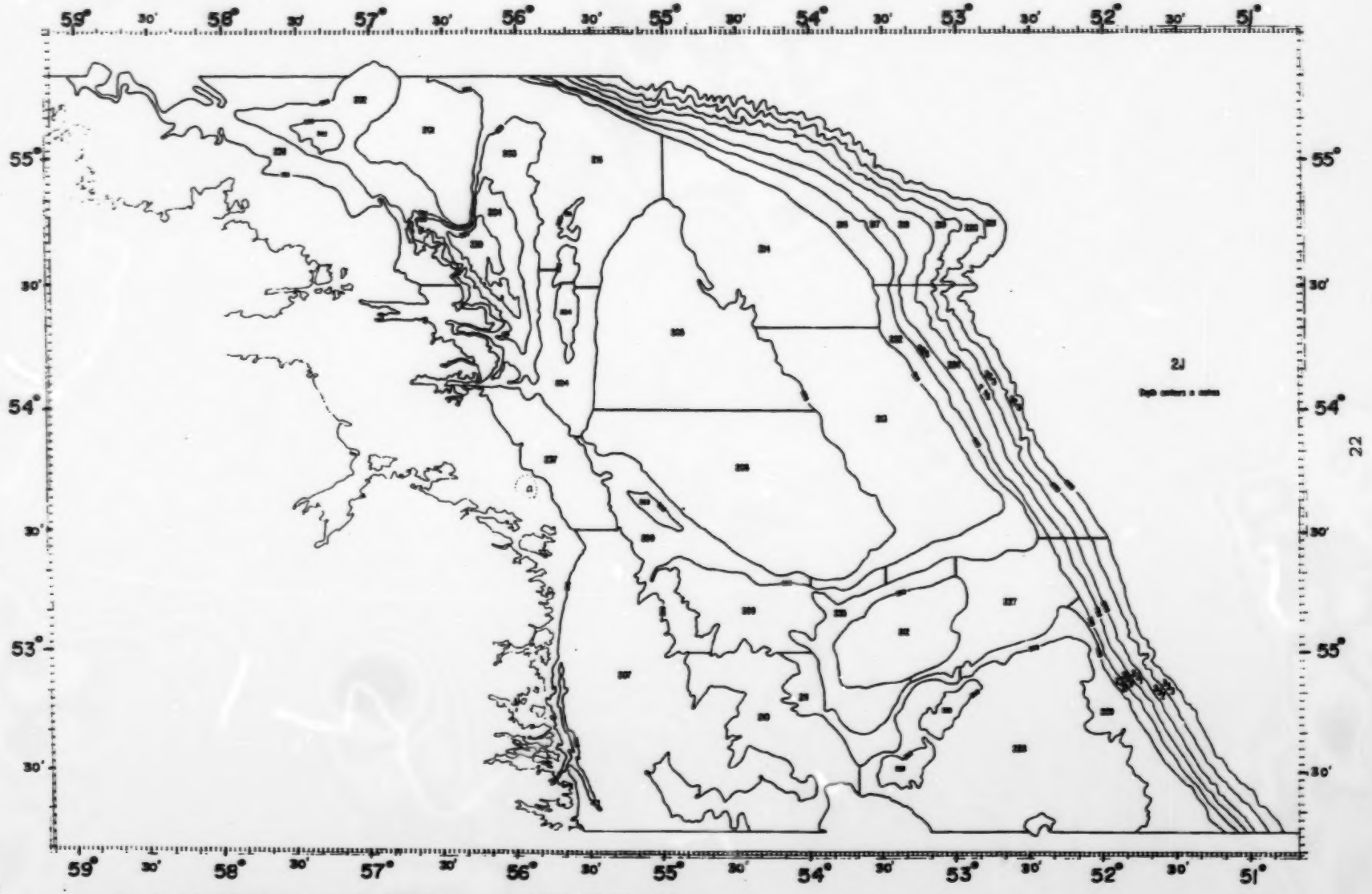

Fig. 3. Stratification used in trawl surveys of NAFO Div. 2J.

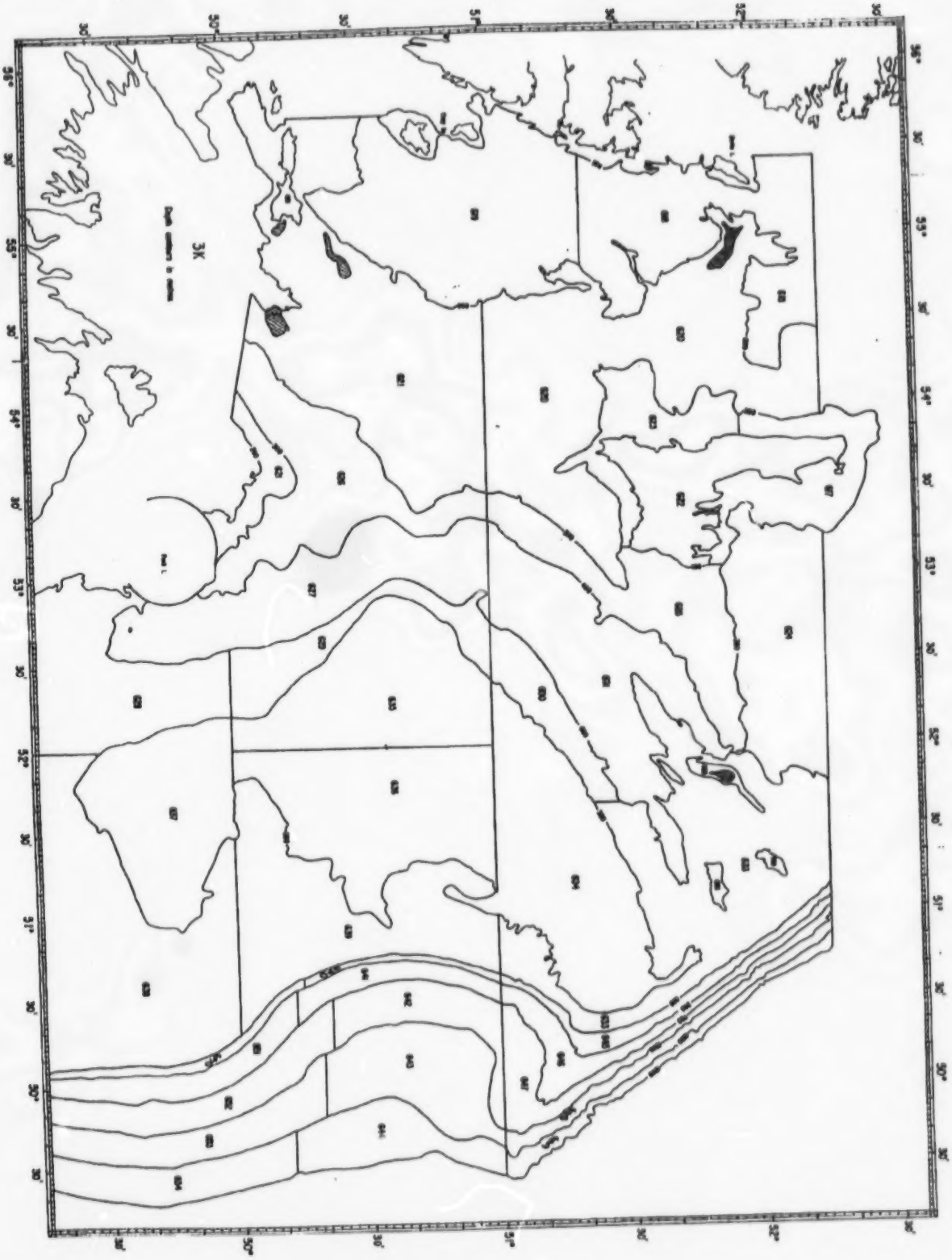

Fig. 4. Stratification used in trawl surveys of NAFO Div. 3K.

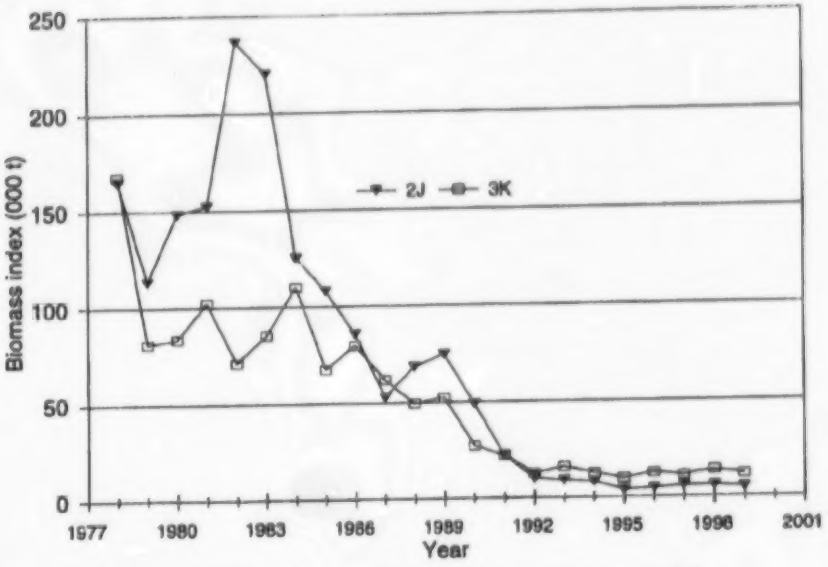

Fig. 5. Biomass index (000 tons) of A. plaice, in Campelen units, from fall surveys, 2J3K.

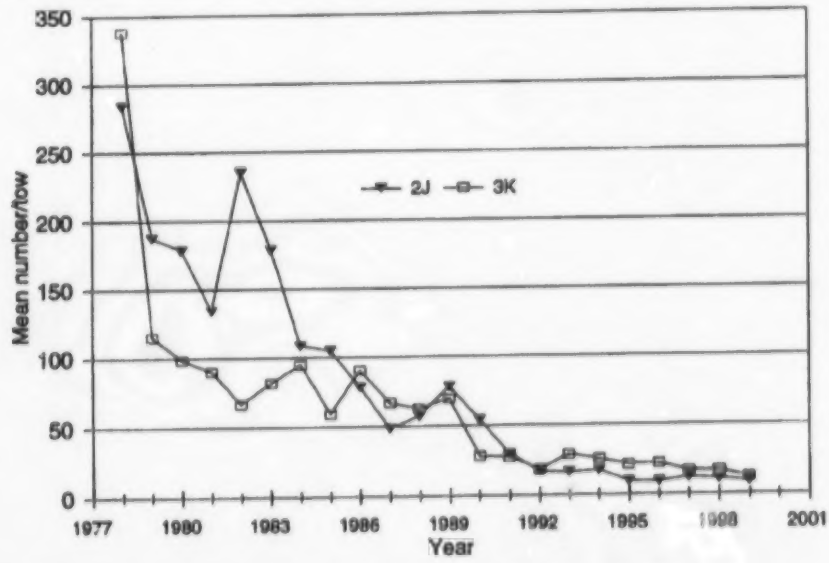

Fig. 6. Mean number per tow of A. plaice, in Campelen units, from fall surveys, 2J3K.

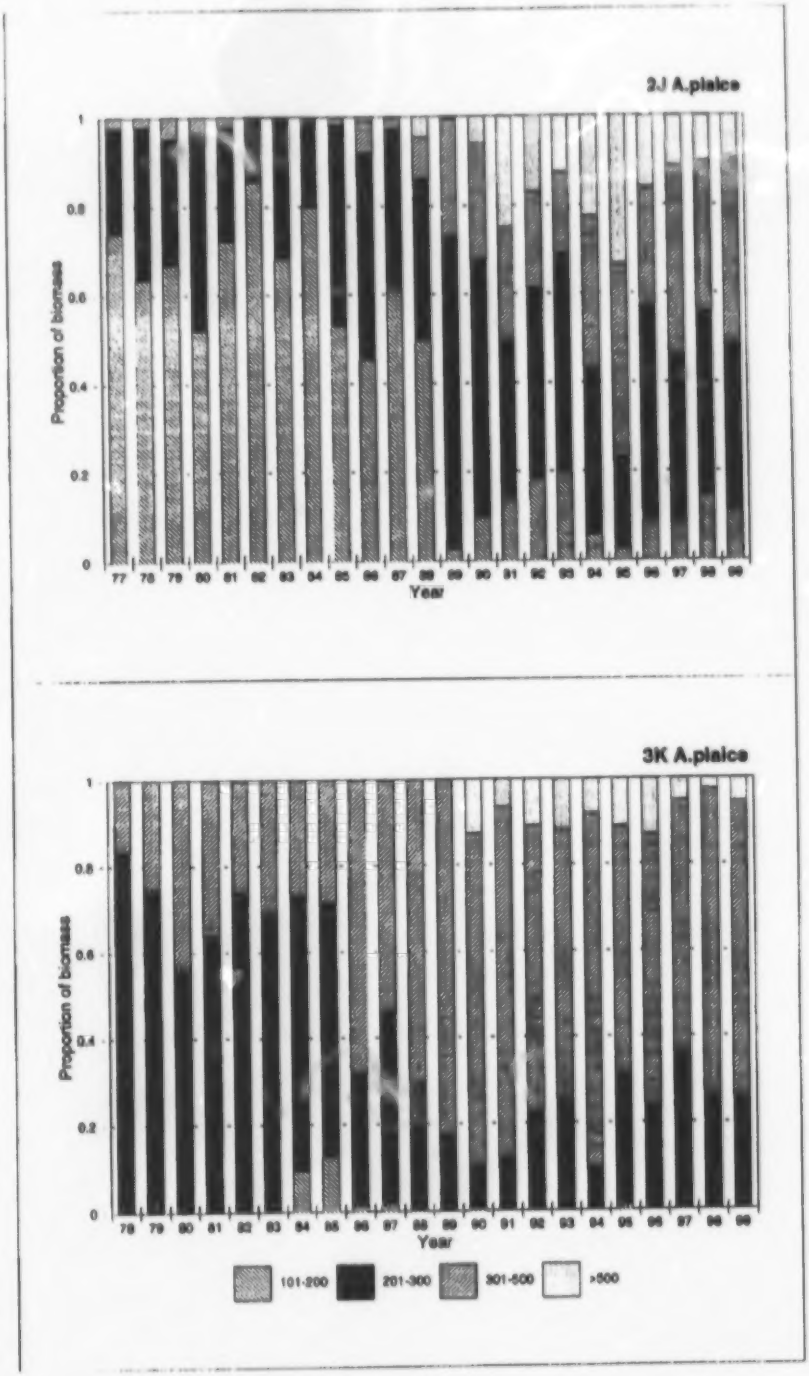

Fig 7. Proportion of biomass, by depth zone, A. plaice in Div. 2J and 3K. Data for 1977-94 are unconverted Engel data, 1995-99 are Campelen data.

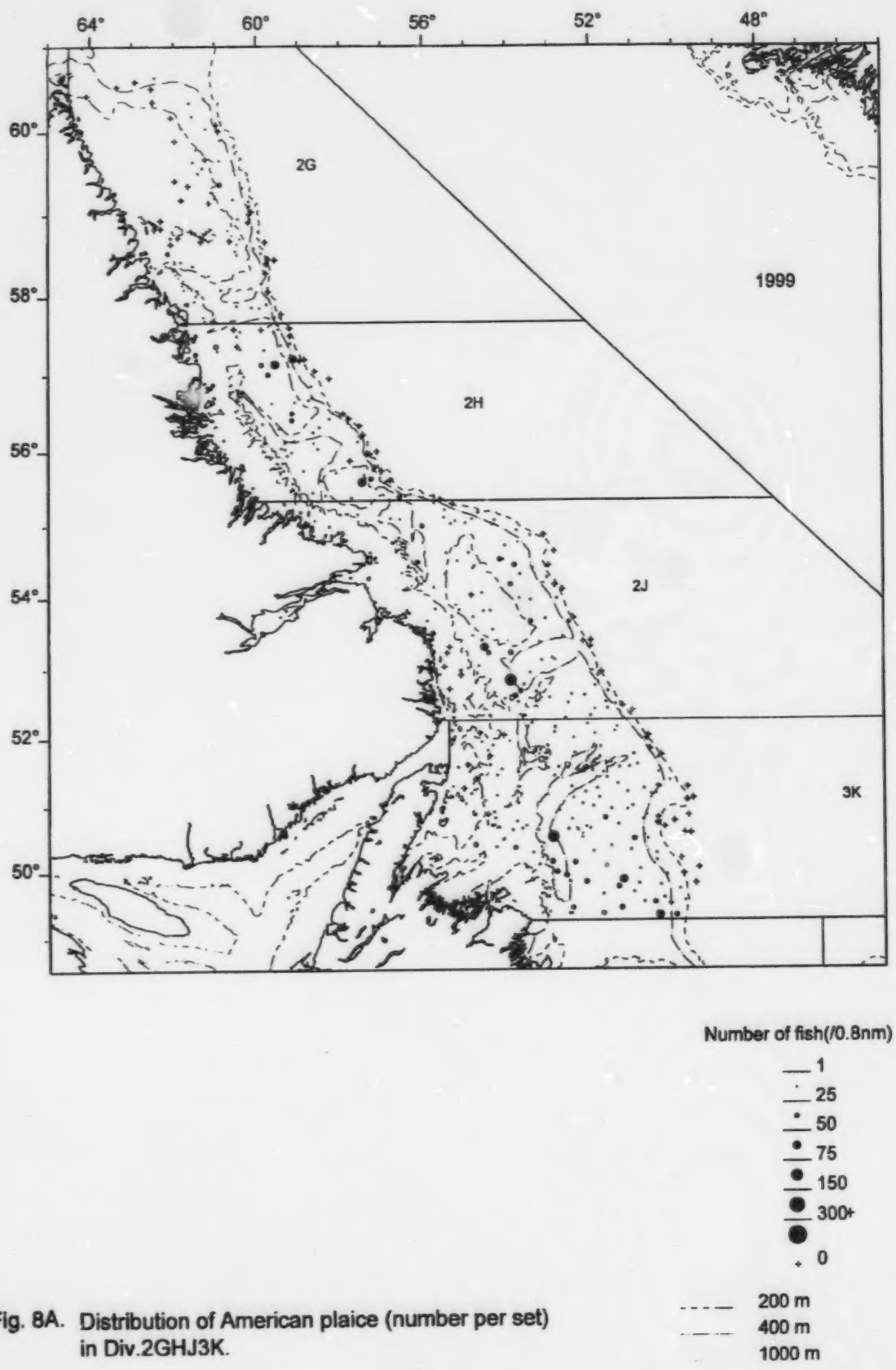

Fig. 8A. Distribution of American plaice (number per set) in Div.2GHJ3K.

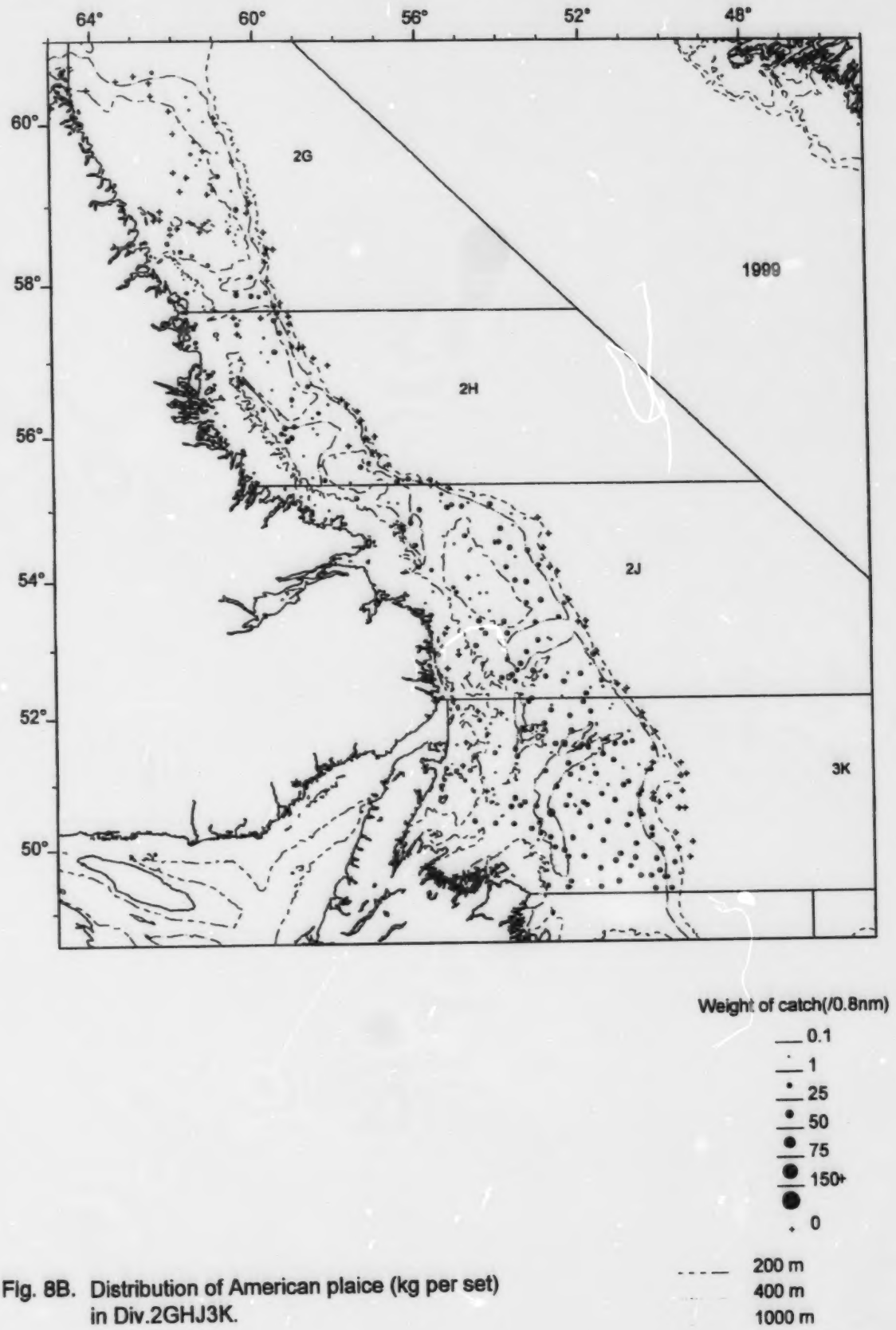

Fig. 8B. Distribution of American plaice (kg per set) in Div.2GHJ3K.

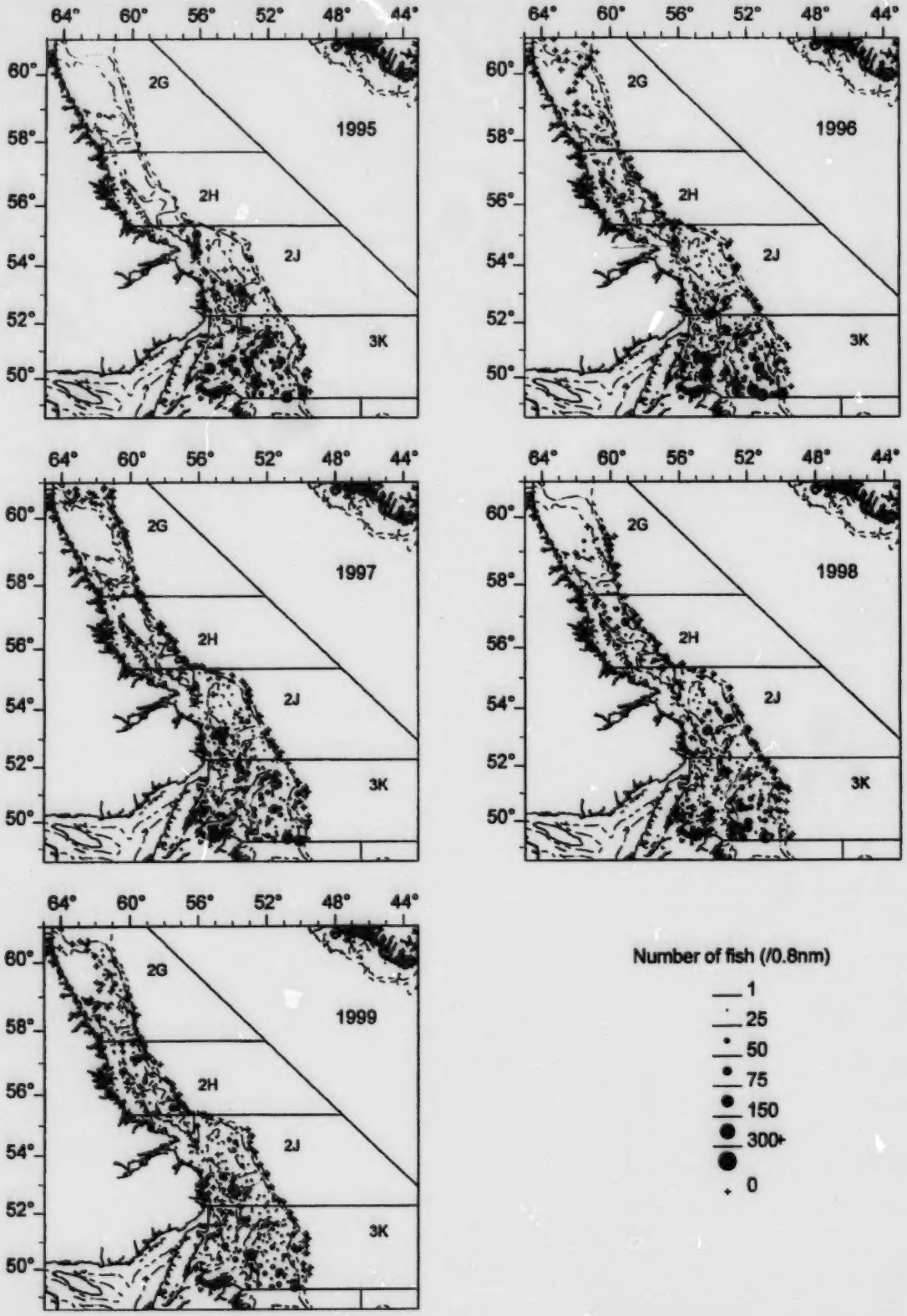

Fig. 9. Distribution of American plaice (number per set) in Div.2GHJ3K.

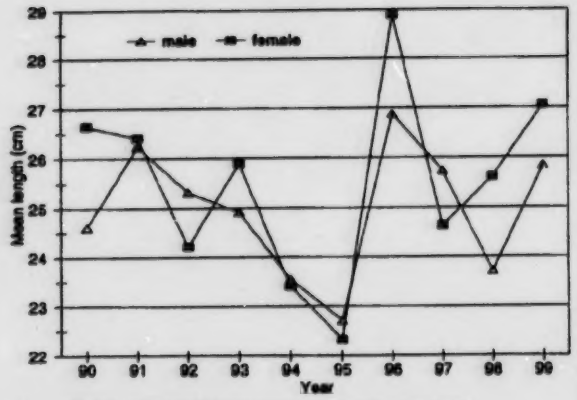

Fig. 10 A Mean size of 6 year old American plaice from surveys in Div. 2J.

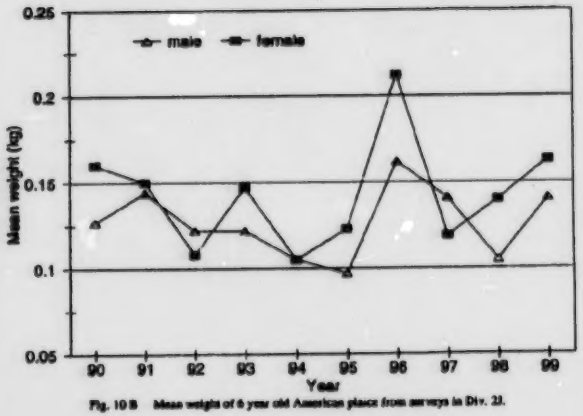

Fig. 10 B Mean weight of 6 year old American plaice from surveys in Div. 2J.

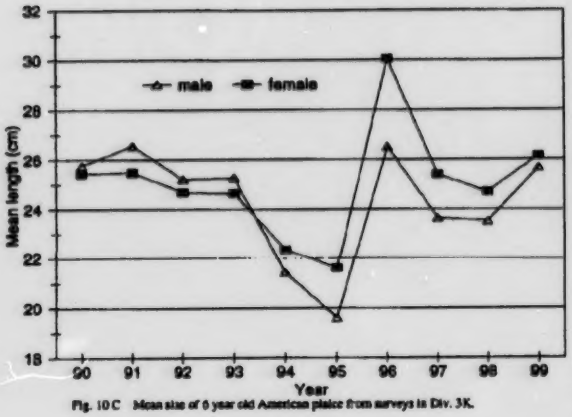

Fig. 10 C Mean size of 6 year old American plaice from surveys in Div. 3K.

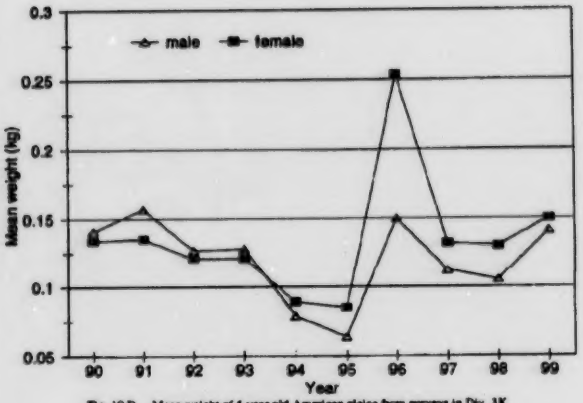

Fig. 10 D Mean weight of 6 year old American plaice from surveys in Div. 3K.

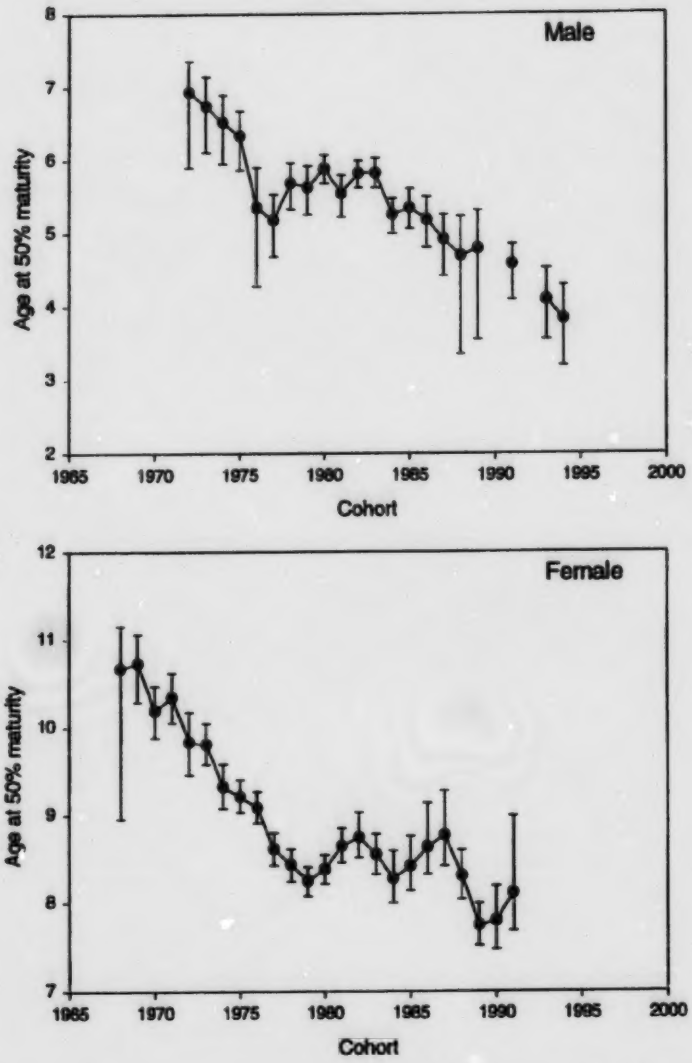

Fig. 11. Age at 50% maturity by cohort for male and female American plaice in Div 2J3K

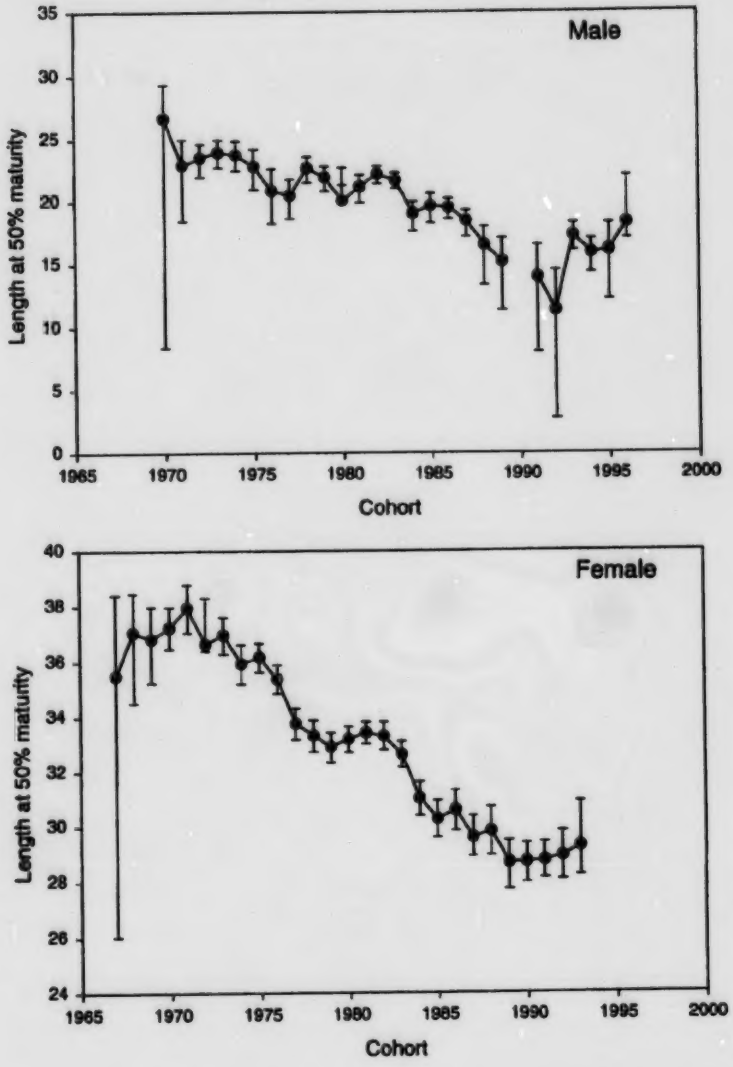

Fig. 12. Length at 50% maturity by cohort for male and female American plaice in Div 2J3K

Fig.13. Total mortality from survey estimates of abundance, 2J3K, ages 8+ in yr n compared to 7+ in yr n-1.

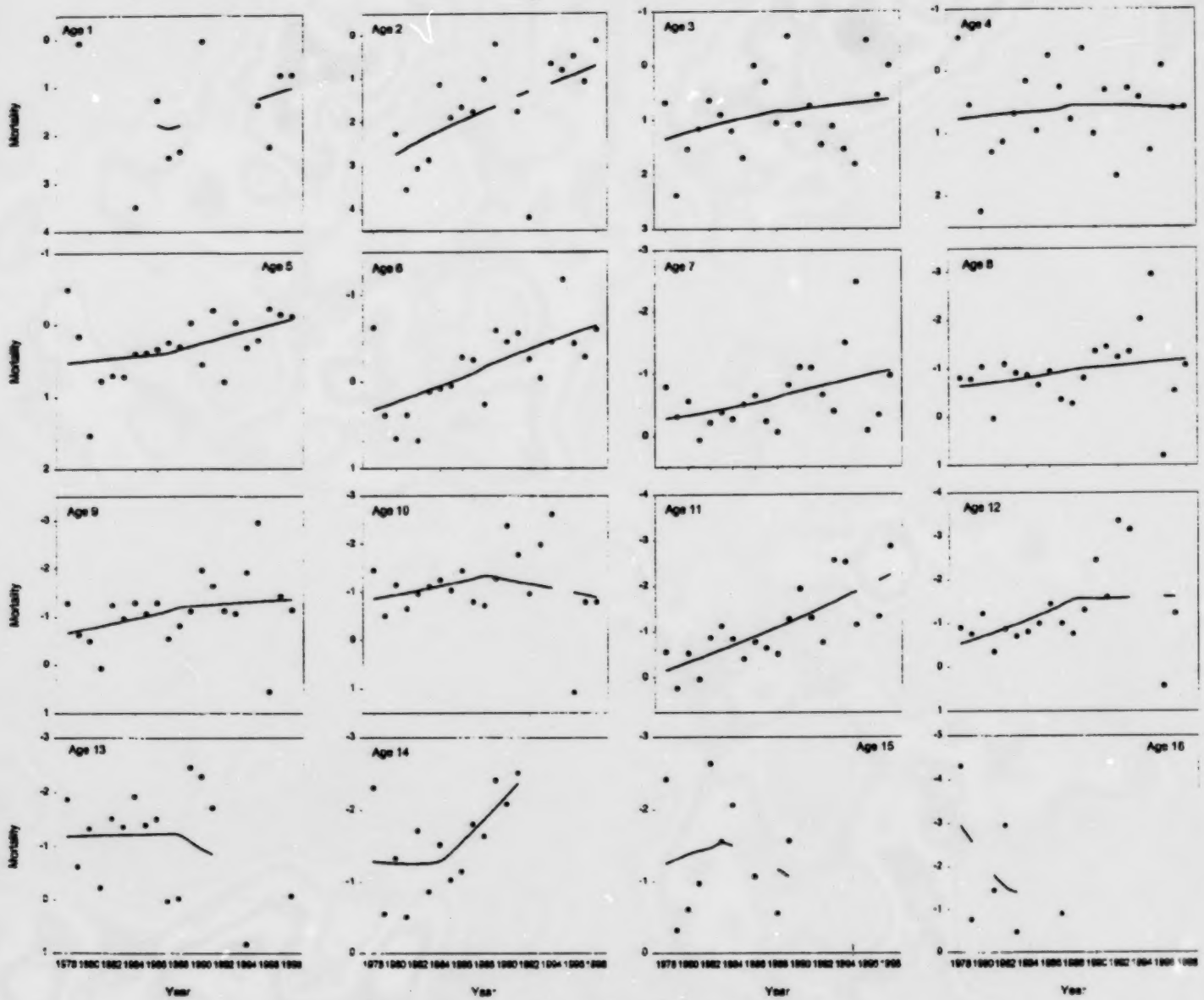

Fig. 14. Estimates of mortality for ages 1 to 16 from fall surveys from 1978 to 1999.

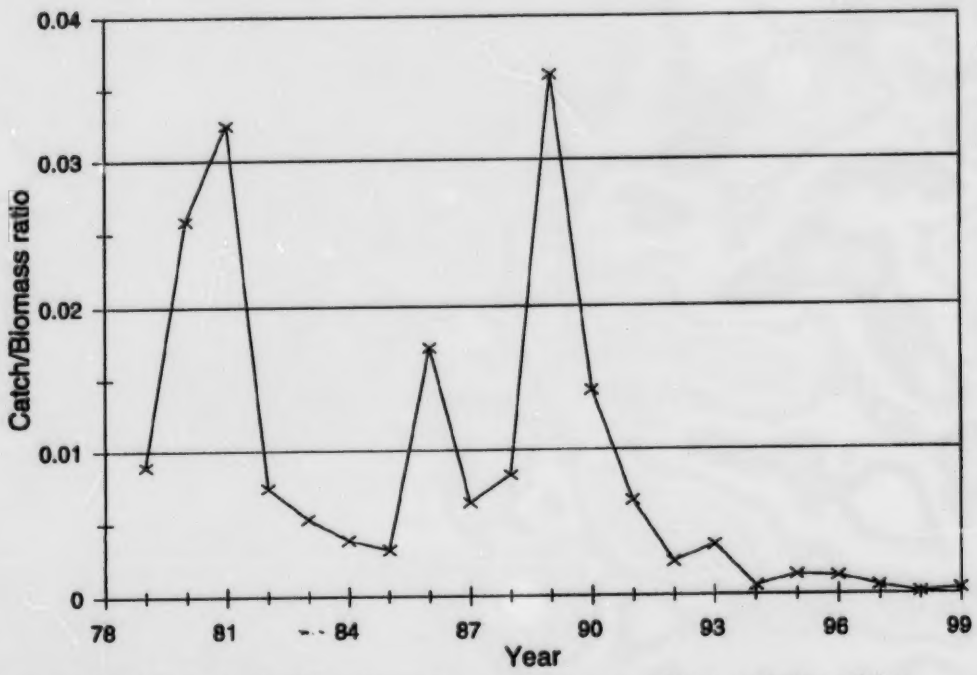

Fig. 15. Ratio of catch (2+3K) to Campelen survey biomass (2J3K), American plaice.

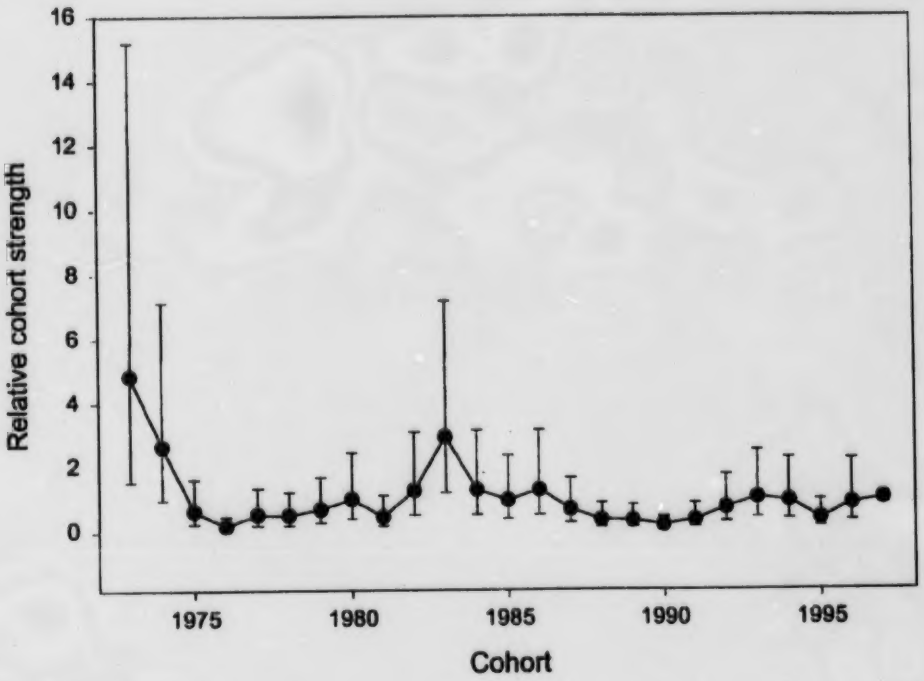

Fig. 16. Relative cohort strength as estimated from a multiplicative model of data from fall RV surveys from 1978 to 1999.